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ECONOMIC CRITERIA FOR EVALUATING POWER TECHNOLOGIES IN LESS DEVELOPED COUNTRIES

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ECONOMIC CRITERIA FOR EVALUATING POWER TECHNOLOGIES IN LESS DEVELOPED COUNTRIES

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I. INTRODUCTION

1. The objec. of the present paper is to indicate the general nature of criteria relevant for choice among power technologies in less developed countries. Special considerations for the emergent nations arise out of (1) abundant manpower and in some cases high unemployment, (2) high capital costs, (3) limited public budgets, (4) high foreign exchange requirements and (5) limited power markets. Each of these considerations is taken into account in the order given. The criteria for evaluation of power projects are developed from the standpoint of the interest of society or the nation as a whole rather than the management of an individual enterprise.

2. Economic criteria for the introduction of power technologies are similar to the criteria relevant for choice among alternative investments in general. The object in all cases is to provide the maximum benefits to society from the available land, labor and capital. Benefits are defined by the goals of a society and costs are defined by the natural resources and skills of a people, both of which change over time.

3. For present purposes, only economic goals will be considered in defining benefits. The most important economic goal is usually an increase in per capita gross national product. A second goal differing in relative importance among different countries is reduction of unemployment (whether concealed or conspicuous). One method of reconciling these goals is to exclude the wages of otherwise unemployed labor in determining costs of specific projects, thus assigning a value to the increase in employment equal to the cost of the previously unemployed labor. If this is done, an advantage will, of course, accrue to projects that increase employment.

4. A general solution to the problem of choice involves the maximization of the difference between costs and benefits for all the projects considered for installation in a given planning period. This involves the following steps: (1) the choice of projects to be considered whose net benefits appear sufficiently promising at first glance to warrant closer study; (2) the identification of benefits arising from each project and determination of the money value of such benefits throughout the life of the project; (3) determination of corresponding costs for each project; (4) the discounting of

both costs and benefits to adjust for differences in time at which they are experienced in each project; and (5) the maximization of the economy-wide excess of benefits over costs, subject to constraints. Step 5 consists in selecting those projects whose net benefits are greatest, within the limits imposed by available budgets, foreign exchange and any other constraints. The present paper is concerned primarily with steps 4 and 5. It assumes that steps 1, 2, and 3 have already been completed.

5. The net benefits from a project are the difference between its gross benefits, or the value of output, and its costs. Gross benefits may be considered as the total revenue from the sale of output or, if output is to be distributed without charge, as the equivalent value in money terms. When considering benefits from the over-all social point of view, proper allowance must also be made for benefits attributable to the project which accrue to others or to society as a whole. For example, in the case of a hydroelectric project, benefits from flood control are generally estimated.

6. Offsetting the benefits from each project are its costs. These consist of capital and the operating expenses, including labor, fuel, other materials and overhead. Taxes may be omitted as a cost when judging public projects, but they are included where a choice among projects is being made by a private business organization. As in the case of benefits, proper allowance must be made for costs attributable to the project, which would be borne by others or by society as a whole. Such costs might include labor training and family relocation.

II. NET BENEFIT MAXIMIZATION

1) The Time Element

7. The economic variables have two different temporal characteristics. Capital expenditures are typically made in a lump sum at the beginning of a project. Operating expenditures are incurred more or less continuously during the life of a project. Gross benefits are similarly received on a relatively continuous basis. Some way must be found to reduce these variables to a temporal common denominater.

8. Two general alternatives are available to take account of the time element. Either capital costs can be spread to an equivalent annual flow comparable with operating expenses, or operating expenses and the value of output can be telescoped to the same point in time as capital costs. The former is known as the annual flow approach; the latter is known as the present value approach. Both have special utility in different circumstances.

2) Annual Flow Method

9. Annual equivalent capital flows are calculated by dividing capital costs by $\sum_{t=1}^{n} \frac{1}{(1+r)^t}$, which will be referred to henceforth as the "discount factor." The terms in the discount factor have the following meanings: r represents time rate of discount, t is a running index of the number of years that have passed since investment in the project, and the term n represents the estimated life of the project in years. With capital costs reduced to an annual equivalent flow

they can be considered comparable with annual operating costs. Annual net benefits can then be readily calculated by subtracting all annual costs, including annual equivalent capital costs, from the annual value of output.

10. The results derived from the above calculations are the same as would be found by using the sinking fund method of calculating depreciation and separately including an explicit interest cost. The annual flow method of calculation described here is mathematically simpler and more correct in economic conceptualization, however, than the sinking-fund approach. Still another method of obtaining annual capital flows, the method of straight-line depreciation, is to be avoided when making cost comparisons between projects. Straight-line depreciation leads to large errors for such capital-intensive projects as hydroelectric plants.

3) The Rate of Time Discount

11. If capital is obtained by borrowing, then the rate of time discount is the rate of interest on the loan. Since power projects in less developed countries may require substantial amounts of imported capital, this rate of interest is often determined in a world market.

12. A different situation is found where capital is obtained by taxation. No interest is explicitly paid on capital obtained by taxation, but governments acting on behalf of their people will wish to invest with regard for the time preferences of individuals. The reason for taking account of time preferences is that a capital investment requires that current consumption be foregone. In place of current consumption is the stream of expected future outputs of the project. The rate of time preference reflects the disutility of waiting for these outputs to become available over the life of the projects and the uncertainties of the future.

13. Two kinds of considerations are relevant in choosing a numerical value of r, the time rate of discount: (1) the preferences of individuals based on their own utilities as affected by personal consumption and work patterns; and (2) collective needs as seen from an organic view of society. It can be shown that a rate of time discount based on consideration number (1) is approximated as the harmonic mean of the time rates of discount of the individuals who will benefit from the project. A social rate of time discount based on consideration (2) should take proper account of the welfare of future generations as well as individuals living today. Such a rate of time preference would seem to require that individual taxpayers be willing to sacrifice some of the satisfactions they anticipate in their lifetimes on behalf of future generations. Unfortunately there is no precise formulation known to the author that will reveal the empirical magnitude of this time preference. This is a matter on which governments must make their decisions with full recognition of the implications of their actions on the choice among alternative projects.

4) Numerical Example of Project Selection Using Annual Flows

14. The implications of the annual flow method are illustrated in Table I, which demonstrates the individual and joint effects of differences among three hypothetical power projects in regard to capital costs, operating costs, useful lifetimes and rates of time discount. The assumed values used for comparison are shown in Part A of Table I. The three projects include a hydro plant, a

TABLE I

Illustrative Examples of Production Costs and Net Benefit Calculations
for Three Alternative Power Plants of 10,000kw Capacity Each.
Assumed to operate 5,000 hours a year

Part A. Assumed Values

Plant	Cost (dollars) (1)	Expected Lifetime (years) (2)	All Operating Costs (mills per kwh) Total (3)	Labor (4)	Fuel (5)	Operation & Maintenance (6)	Annual Operating Cost (dollars) (7)
Hydro	5,000,000	50	1.0	0.8	0.0	0.2	50,000
Steam	2,000,000	30	8.2	2.2	5.8	0.2	410,000
Diesel	1,000,000	15	8.8	1.0	7.6	0.2	440,000

Note: Gross benefits(in the present case gross revenue) are assumed to accrue at the rate of 20 mills per kwh. The total value of annual output is 10,000 x 5,000 hours x $.02/kwh = $1 million.

Part B. Annual Flows (thousands of dollars)

Plant	Rate of Time Discount = 0% Gross Benefit (1)	Capital Cost (2)	Operating Cost (3)	Net Benefit (4)	Rate of Time Discount = 5% Gross Benefit (5)	Capital Cost (6)	Operating Cost (7)	Net Benefit (8)	Rate of Time Discount = 10% Gross Benefit (9)	Capital Cost (10)	Operating Cost (11)	Net Benefit (12)
Hydro	1,000	100	50	800	1,000	274	50	676	1,000	505	50	445
Steam	1,000	67	410	523	1,000	130	410	460	1,000	212	410	378
Diesel	1,000	67	440	493	1,000	96	440	464	1,000	132	440	428

Part C. Present Values (million dollars)

Plant	Rate of Time Discount = 0% Gross benefit (1)	Capital Cost (2)	Operating Cost (3)	Net Benefit (4)	Rate of Time Discount = 5% Gross Benefit (5)	Capital Cost (6)	Operating Cost (7)	Net Benefit (8)	Rate of Time Discount = 10% Gross Benefit (9)	Capital Cost (10)	Operating Cost (11)	Net Benefit (12)
Hydro	50.0	5.0	2.0	43.0	18.3	5.0	.9	12.4	9.9	5.0	.5	4.4
Steam	30.0	2.0	12.3	15.7	15.4	2.0	6.3	7.1	9.4	2.0	3.9	3.5
Diesel	15.0	1.0	6.4	7.6	10.4	1.0	4.6	4.8	7.6	1.0	3.3	3.3
Diesel with replacement	30.0	2.0	12.8	15.2	15.4	1.5	6.8	7.1	9.4	1.3	4.2	3.9

Source: Part A values assumed, except that column (7) derived as product of column (3) x 50,000,000 kwh, the assumed annual output of each plant.

Part B values derived as follows:
Columns (1), (5), and (9) -- See Note to Part A.
Columns (2), (6), and (10) -- Derived by dividing capital cost figures from column (1), Part A, by discount factor $\sum_{t=1}^{n} \frac{1}{(1+r)^t}$ By simple algebraic manipulation, it can be shown that $\sum_{t=1}^{n} \frac{1}{(1+r)^t} = \frac{1-(1+r)^{-n}}{r}$, the expression generally used for present value of annuity in mathematical tables.
Columns (3), (7), and (11) -- Annual operating costs are assumed to be constant over the life of each plant, hence these values are the same as those in column (7), Part A.
Columns (4), (8), and (12) -- Derived from preceding three columns.

Part C values derived as follows:
Columns (1), (5), and (9) -- Annual gross benefit cumulated over the lifetime of each plant and discounted at the indicated rate.
Columns (2), (6), and (10) -- Since capital outlay is assumed to be made at the initiation of the project and in one lump sum, the present value is equal to the actual outlay as shown in column (10, Part A, except for the "diesel value with replacement" figure which also includes the present value of a second diesel plant costing $1 million installed 15 years later.
Columns (3), (7), and (11) -- Derived as the present value of the annual operating cost figures indicated rate, i.e. multiplied by discount factor.
Columns (4), (8), and (12) -- Derived from preceding three columns.

steam plant, and a diesel plant. Of these, the hydro plant is the most capital intensive and has the lowest operating costs, and the diesel plant is at the other end of the scale in both of these regards. Although the particular values chosen for the example are hypothetical, they are not unrepresentative of actual conditions at many places around the world. The example is intended only as an illustration of methodology, and not to provide a basis for judgments regarding the relative economic merits of possible power plants either at particular locations or in general. 1/

15. Part B shows a comparison of annual flows, including annual equivalent capital flow costs for each of the three technologies. The principal point to be noted is the increase in the relative merits of the less-capital-intensive technologies, particularly diesel, as higher time rates of discount are considered. The hydroelectric facility continues to show greatest net benefits throughout the range of rates of time discount used in the table, but the effect of its great capital intensivity is clearly apparent in narrowing the net benefit differences. At still higher rates of time discount, the diesel plant would actually result in greater net benefits than the hydroelectric plant. The small difference in capital intensity, or relative proportion of capital to total costs, between steam and diesel accounts for the reversal in the relative ranking of these two technologies between 0 and 5 percent rate of time discount. For 2 or 3 percent rates, steam would result in greater net benefits than diesel.

16. A different result could have been obtained if different gross benefits had been assumed. For example, if the hydroelectric plant could only be constructed in a remote area with a low demand for electric power, or if stream flow were so irregular and output quality so poor that power could only be sold at low rates, the value of output might be only 10 mills per kilowatt-hour at the hydro plant busbar. Annual gross benefits for the hydro project would only be $500,000 and there is no interest rate at which it would be preferable to either of the other plants.

5) Comparison of Present Values with Annual Flows

17. Present values are defined as the worth of expected future outputs and costs when viewed from the standpoint of the present time. The present value of gross benefits is the yearly rate of gross benefits expected multiplied by the discount factor. The present value of operating expenses is the yearly rate of expected operating expenses multiplied by the discount factor. If capital investment is made at the point in time at which the present value is calculated, the investment itself is the present value of the investment and no multiplication by the discount factor is necessary for capital. It will be noted that present values differ from annual flows by a constant multiple, the discount factor. The economic significance of this difference, however, is quite considerable, as will be seen by reference to Part C of Table I.

1/ It may be argued that the example is unfair to steam and hydroelectric power generation on the grounds that both have lower per kilowatt-hour costs in larger sized installations. In an empirical study it would be appropriate to consider all sizes of power plants and map out the circumstances in which each is best. This, however, is not possible within the limits of the present analysis and is also not relevant for present purposes.

18. Part C gives the same comparison as Part B, but on the basis of present values. Consider the first three lines of Part C. The ranking of the steam and diesel projects is reversed from what it was in Part B at the 5 and 10 percent rates of time discount. The reason is easiest to see at the zero rate of time discount. As there shown, net benefits are more than twice as high for steam as for diesel. This is because the steam project lasts twice as long as the diesel project. At the zero rate of discount, no account is taken of time differences and the greater longevity of the steam project has an unqualified effect. Annual differences in net benefits are not great between the steam and diesel projects, but net benefits accumulate over twice as long a time for the steam project. The longer life of the steam project is thus responsible in large degree for its comparatively better showing than diesel at the 5 and 10 percent rates of time discount.

19. The fourth line of Part C shows present values for two diesel projects, the second to be installed fifteen years after the first, resulting in a combined total life of both diesel installations equal to the life of the steam project. (It will be noted that the value of capital continuously decreases due to time discounting of the second project.) If line 4 is used to represent the diesel facilities and is compared with line 2 representing the steam facilities, then the same ranking of the two projects results as in Part B, within the rounding error of the figures. (The apparent difference at the 5 percent rate of discount is due to rounding.)

20. If the same sort of comparison were made between the hydroelectric project and either of the other two projects, it would be necessary to make the replacements terminate after the same number of years. An alternative is to calculate the present value of infinite replacements and compare projects on this basis. 2/ It can be shown that the ratio of present values so calculated would be the same as the ratio of annual values using equivalent annual capital costs as previously described.

21. This does not lead to the conclusion that equal time periods must be employed in comparing public projects. As will be noted below, the present value method of comparison for projects with different lifetimes is superior for most practical problems of project selection. The principal object of Part C is to indicate wherein the annual flow and present value methods differ.

6) The Problem of Choice

22. The annual flow method of calculating costs is the best choice for ranking power projects when there are no restrictions on choice such as might arise from budgetary limits or scarce foreign exchange. That is to say, the annual flow method is satisfactory when benefits and cost comparisons are made in the abstract and in the absence of the economic restrictions normally attending project selection. On the other hand, where restrictions are effective, as in almost every practical problem of project selection, present values subject to constraints must be employed.

2/ This is, in fact, the approach used by Alchian, A. A., Economic Replacement Policy, Rand Corporation Report-224 (Santa Monica, California, 1952).

23. The choice of one technology in preference to another is usually made from the viewpoint of a single annual budget or, at most, a limited number of budgets from which a limited number of replacements are contemplated, not from a stream of costs and benefits the equivalent of which is infinite replacement. When comparisons of net benefits are made from a fixed point in time, the fact of greater longevity of one project over another is a point in favor of the longer lived project.

24. Secondly, the size of the annual budget from which expenditures are made on power projects is generally limited by a variety of factors outside the confines of the present discussion. Any project that gives a positive value for annual net benefits is worth the money put into it if there is no other use for the money. Actually, of course, there are usually other uses for the money, and so the problem becomes that of somehow taking account of alternatives foregone. For present purposes, it is necessary to avoid a part of this problem by taking as given a sub-budget devoted exclusively to power projects. A remaining part of the problem, which cannot be avoided, however, is the apportionment of the scarce funds in the sub-budget among power projects.

25. A third consideration is that foreign exchange often exercises an equally effective constraint on the choice of projects. Thermal power generating equipment, for example, may be available only through imports. This being the case, limits on foreign exchange must be considered in the same way as budgetary limits on investment funds. A related, though different problem arises when foreign exchange is used for fuel imports. 3/

26. Other constraints arise from complementarities and incompatibilities among power projects. As an example of complementarities, it might be preferable to install both a diesel and a small steam power plant in preference to a large single steam plant of the same total capacity in order to take advantage of the suitability of the two smaller plants to varying load factors in the power system. In such a case, the two smaller plants are complementary. Incompatibility, on the other hand, is reflected in the physical impossibility of constructing two different hydroelectric plants at the same site or the economic unsuitability of building two different power plants to satisfy the same demand.

27. Following a method described in detail by the author elsewhere 4/, the considerations listed in the foregoing paragraphs can be included in the analysis by ranking power projects according to equation 1. The method is presented here from the viewpoint of public project planning in an economy with

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3/ There is another context in which foreign exchange effects need not be considered for the planning of power projects. This is in the importing and exporting of power itself. Very little power moves in international trade and this is largely in the form of electricity across the borders of adjacent countries. Therefore, no account need be taken of foreign power costs or of potential competition by foreign suppliers in the domestic market. In this respect, the planning of power investments is different from that of most investments in manufacturing, agriculture and extractive industries.

4/ Forthcoming in United States publication of papers presented at this conference. The method on which the analysis is based is an adaptation of an approach developed by Steiner, P. O., "Choosing Among Alternative Public Investments", American Economic Review, Vol. 49 (December, 1959).

an important private sector. Adaptations of the method can be made for project selection in an economy without an important private sector and for project selection within a private business firm.

28. The method is based on a recognition that funds available for public power projects and foreign exchange have productive uses elsewhere. The object is to be sure that power project uses of funds and foreign exchange are more valuable than the alternative uses of the same funds and foreign exchange. With this end in view, the formulation makes two correctives. First is the corrective (represented by the term c_1k) for other productive uses of funds (backlog projects) in the power project budget. Second is the corrective (represented by the term c_2h) for other productive uses of foreign exchange. Each of these correctives can be determined empirically but not without a more extensive analysis than it is possible to report here. 5/

$$\bar{Z} = \bar{B} - c_1k - c_2h \quad \ldots\ldots\ldots\

TABLE II

Adjustment of Present Value of Net Benefits
(Figures are in millions of dollars except for the coefficients c_1 and c_2. Calculations are based on r = 5 percent)

Part A
(c_1 = 0.6, c_2 = 0.7)

	Hydropower		Steam		Diesel	
Net Benefits, $\bar{B}$		12.4		7.1		4.8
$c_1 k$	0.6x5.0 = 3.00		0.6x2.0 = 1.2		0.6x1.0 = 0.6	
$c_2 h$	0.7x0.3x5.0 = 1.05		0.7x0.8x2.0 = 1.12		0.7x0.8x1.0 = 0.56	
		-4.05		-2.32		-1.16
Adj. Net Benefits, $\bar{Z}$		8.35		4.78		3.64

Part B
(c_1 = 2.0, c_2 = 0.7)

	Hydropower		Steam		Diesel	
Net Benefits, $\bar{B}$		12.4		7.1		4.8
$c_1 k$	2.0x5.0 = 10.0		2.0x2.0 = 4.0		2.0x1.0 = 2.0	
$c_2 k$	0.7x0.3x5.0 = 1.05		0.7x0.8x2.0 = 1.12		0.7x0.8x1.0 = 0.56	
		-11.05		-5.12		-2.56
Adj. Net Benefits, $\bar{Z}$		1.35		1.98		2.24

Source: Values of net benefits, $\bar{B}$ are from Table I, Part C, Column (8), first 3 lines. Other terms are calculated according to equation 1 of the text using assumed values for c_1 and c_2 as indicated.

TABLE III

Total Net Benefits with Power Project Budget of $7.0 Million
(Figures are in millions of dollars, except for c_1 and c_2)

Part A
(c_1 = 0.6, c_2 = 0.7)

Hydropower	12.4	Hydropower	12.4
Steam	7.1	Diesel	4.8
$\bar{B}$	19.5	Backlog projects 0.6x1.0	0.60
		h adjustment 0.7x0.8x1.0	0.56
		$\bar{B}$	18.36

Part B
(c_1 = 2.0, c_2 = 0.7)

Hydropower	12.4	Hydropower	12.4
Steam	7.1	Diesel	4.8
$\bar{B}$	19.5	Backlog projects 2.0x1.0	2.0
		h adjustment 0.7x0.8x1.0	0.56
		$\bar{B}$	19.76

Source: Net benefits for hydroelectric, steam and diesel are from Table I, Part C, column (8), first 3 lines. Backlog projects and h adjustments are calculated as indicated using corresponding values of c_1 and c_2.

Table II, which is an extension of the example shown in Table I.

31. Table II uses the same present values for the same three power technologies as in the first three lines of Part C, Table I at the 5 percent rate of time discount. Part A of Table I assumes the following values for the coefficients: $c_1 = 0.6$ and $c_2 = 0.7$. It also assumes that eighty percent of the value of plant and equipment is imported ($h = 0.8k$) for diesel and steam power, but only 30 percent is imported ($h = 0.3k$) for hydropower. Part B of Table II is based on the same assumptions as Part A except that a value of $c_1 = 2.0$ is used. Although it is not possible to present here the details for calculation of the c_1 coefficient, the contrast between the values for c_1 in Parts A and B is clearly a contrast between a slack and a tight power project budget. The smaller the budget for power projects, all other things equal, the greater will be the value of any additional funds and hence of c_1.

32. Now, consider the following situation. Suppose the total available budget for powerplants is $7.0 million, that the hydroelectric plant is considered for one site and the diesel and steam plants are alternatives for another site. The requirement of compatibility prevents the construction of both diesel and steam plants, but does not prevent the construction of the hydroelectric plant and either of the other two.

33. According to the $\bar{Z}$ values shown in Table II, which are calculated following equation 1, the hydroelectric and steam projects should be constructed with $c_1 = 0.6$, while the hydroelectric and diesel projects should be undertaken with $c_1 = 2.0$. The implications of the adjustment of net benefits according to equation 1 are illustrated in Table III, where the total net benefits for each of the two alternative combinations of projects are shown for $c_1 = 0.6$ (Part A, Table III) and $c_1 = 2.0$ (Part B, Table III). The results confirm the preceding selection based on Table II. The highest total net benefits with $c_1 = 0.6$ are found in the hydroelectric and steam projects; with $c_1 = 2.0$, the highest net benefits result from expenditure on the hydroelectric and diesel projects. The $1 million that is freed by installing the diesel rather than the steam project is spent on backlog projects. The $0.56 million of foreign exchange that is freed by the installation of the diesel rather than the steam project is likewise channeled into other uses, which in this example are represented by the c_2 value of 0.7. It is clear that a variety of alternative considerations can influence the choice among the three technologies, involving different combinations c_2 as well as c_1 and different proportions of foreign exchange to total capital cost.

34. If the power projects budget were limited to $6.00 million, it would be necessary to choose between the steam project on the one hand and the hydroelectric plus diesel projects on the other hand. With either the Part A or Part B assumptions, the latter two would win out. A more difficult question is which project to choose if the budget is limited to $5.00 million. According to Table II, the hydroelectric project should be selected if $c_1 = 0.6$ and the diesel project if $c_1 = 2.0$. Calculations analogous to those shown in Table III will confirm the wisdom of these choices.

35. Finally, it is possible that the coal plant might come into more favorable standing as compared with the diesel plant even at values of c_1 in the range of those shown in Part B of Table II if diesel fuel must be imported and coal can be obtained from domestic sources. (The opposite, of course, would be true if coal had to be imported and diesel fuel were available at home.) To this

point, only the effects of foreign exchange on capital have been considered. A more difficult problem arises when foreign exchange is also used for fuel. 7/ This problem cannot be analyzed here except to note that uses of foreign exchange for fuel can exert at least as important an effect on the choice of a power technology as uses of foreign exchange for capital.

III. APPLICATION OF CRITERIA

36. A complete analysis of alternatives should consider the effects of different sized installations of the different technologies. Larger scale production installations and lower production costs may be offset by the costs of distributing power over wider market areas. Although the examples have been limited to production cost comparisons, a proper application of the criteria must include transmission and distribution as a part of project costs. It is reasonable to expect that in early stages of economic development, the choice will tend to favor smaller projects because (1) there are few large high-density power markets and (2) transmission and distribution expenses are capital-intensive. Large power installations can be expected to become more numerous in later stages of economic development.

37. Application of the criteria may be complicated in some cases by complementarities between production and use of power. A hydroelectric project might be considered only in conjunction with the manufacture of primary aluminum, or a small diesel facility only in combination with a village refrigeration unit. Complementarities of power production projects with particular power using projects suggest the need for combining the power budget with the appropriate manufacturing budgets, at least for an evaluation of the combined production-use projects. Fortunately, however, production-use complementarities are the exception rather than the rule for power projects (in contrast to the situation in many manufacturing industries). Accordingly, the complications that result from combining budgets can be avoided in most circumstances.

7/ The problem is analyzed by the author in the forthcoming United States publication referred to in footnote 4.

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